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Desirability bias in foresight: Consequences for decision quality based on Delphi results

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ABSTRACT

In foresight activities uncertainty is high and decision makers frequently have to rely on human judgment. Human judgment, however, is subject to numerous cognitive biases. In this paper, we study the effects of the desirability bias in foresight. We analyze data from six Delphi studies and observe that participants systematically estimate the probability of occurrence for desirable (undesirable) future projections higher (lower) than the probability for projections with neutral desirability. We also demonstrate that in the course of a multi-round Delphi process, this bias decreases but is not necessarily eliminated. Arguably, the quality of decisions based on Delphi results may be adversely affected if experts share a pronounced and common desirability for a future projection. Researchers and decision makers have to be aware of the existence and potential consequences of such a desirability bias in Delphi studies when interpreting their results and taking decisions. We propose a post-hoc procedure to identify and quantify the extent to which the desirability bias affects Delphi results. The results of this post-hoc procedure complement traditional Delphi results; they provide researchers and decision makers with information on when and to which extent results of Delphi-based foresight may be biased.

1. Introduction

Foresight activities are essential elements of effective and efficient long-term planning. By addressing possible future developments systematically, decisions makers are able to allocate resources and make more effective (investment) decisions [1–3]. When decisions about far reaching strategies and future developments have to be made, uncertainty is high and decision makers frequently have to rely on human judgment in addition to historical data. In such cases, human judgment can support in the estimation of the probability of events possibly occurring in the future [4]. Thereby, methods which elicit experts' opinions are important instruments to improve decision quality [5,6].

Human beings' forecasts about the likelihood of future events are likely to be biased due to cognitive limitations in the complex process of estimating probabilities, especially when uncertainty is high [7,8]. In order to avoid such biases and to improve the quality of subjective probabilities, the application of the Delphi method has been suggested to be an appropriate procedure [9–11]. Through *(1)* exchange of expert knowledge, *(2)* iteration in the survey process, *(3)* provision of controlled feedback, and *(4)* convergence of probability assessments, the adverse effects of cognitive limitations on probability assessments, such as over-confidence, can be reduced [4,11–14]. However, as Rowe and Wright [15] indicate partially, despite Delphi's ability to improve the quality of probability estimates for future events, the method is not generally capable of eliminating the effects of a so-called 'desirability bias'. Desirability bias occurs when the desirability of an event positively influences the judgment of whether the event is likely to occur and a perceived undesirability of the event would negatively affect the judgment [16]. Thus, prevalence of the desirability bias in Delphi studies would lead experts to assess desirable events as more likely and undesirable events as less likely to occur.

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The effect of desirability bias in Delphi studies can be severe. The desirability bias can distort resulting probability assessments and thus limit the explanatory power of the Delphi forecast. In addition, an obvious consensus among experts, as well as an apparent dissent, could be induced by the desirability bias, and not just by the exchange of information within the survey process. Decision makers using Delphi in foresight have to be aware of and understand the effects of the desirability bias in order to derive appropriate conclusions and recommendations from Delphi results and to ensure reliability of the data that is used to support decision making.

Our paper contributes to existing research by providing empirical evidence for the significant effect that the desirability bias has on experts' probability estimates for far-future, high-impact projections in Delphi studies. Furthermore, we show that the impact of desirability on experts' probability estimates decreases but is not necessarily eliminated during the Delphi process. Finally, we derive complementary information to traditional Delphi results by quantifying desirability's impact and thus stress the consequences of desirability bias for interpretability and quality of decisions based on Delphi results.

We analyze data obtained from six individual Delphi studies in which a total of 200 experts assessed the probability of occurrence and desirability of a total of 134 far-future, high impact projections. We develop and test two important hypotheses on how the desirability of projections of the future impact estimated probabilities of occurrence and how this impact decreases in the course of a multi-round Delphi-process. To test our hypotheses, we deploy several regression models that treat estimated probability as the dependent variable and desirability as the independent variable. We use generalized methods and control for cluster effects, correlations, and variable issues that result from Delphi survey data [17,18]. Based on the insights from these analyses we develop a post-hoc procedure that identifies and quantifies the extent to which the desirability bias affects Delphi results. The results of this post-hoc procedure complement traditional Delphi results; they provide researchers and decision makers with information on when and to which extent results of Delphi-based foresight may be biased.

The remainder of this paper is organized as follows: Following the introduction, we provide a brief review of the theoretical background of major cognitive biases that may apply to Delphi studies. In this context, we also discuss the desirability bias in more detail. Based on this discussion, we derive our research hypotheses and discuss our modeling approach. Our analyses will first focus on the research hypotheses and demonstrate the significance of the desirability bias in experts' estimated probabilities. Thereupon, we highlight the practical implications of our findings and propose a post-hoc procedure to assess the consequences for Delphi-based decision making.

2. Theoretical background and research gap

2.1. Cognitive biases in the context of Delphi studies

When human beings forecast the likelihood of future events, they use simple mental strategies and heuristics to cope with uncertainty and the complex task of estimating probabilities [7]. *Availability, representativeness,* as well as *anchoring and insufficient adjustment* are often said to be three main heuristics in that context [4,19]. Although heuristics can be helpful for humans in making probability estimations, they can yield systematically biased judgments [20]. Among other effects, judgments can be biased in that individuals follow a general tendency to be overly optimistic, overly pessimistic, or overly confident in their predictions, or they believe that they are more likely to experience positive than negative events [7, see 8 for a review on likelihood judgments specifically, 21–23]. The consequences of biased judgments can be severe. An example is the "the planning fallacy" which describes the tendency to underestimate future costs, completion times, and risks and overestimate the benefits of the same actions, leading to overrun projects and excessive costs [24].

The effects of such biases of individuals can be exacerbated if forecasts are performed in a group [25]. In addition, the way in which group members interact, how individual estimates are aggregated, or how knowledgeable the group members are, could yield further biases and affect the accuracy of forecasting results [11,25–27]. Consequently, techniques like Delphi, which aim to elicit group judgments and probability estimates, should remedy some of the problems associated with these biases and effects.

The Delphi method is suggested to be efficient in addressing several of the challenges presented above. Through Delphi's four characteristics: *(1) anonymity, (2) feedback, (3) statistical aggregation of group responses,* and *(4) iteration,* experts can achieve more objectified results, such as more objectified probability estimates [28]. As an example of the Delphi method's potential, if participants observe a lack of consensus among other experts in the Delphi process, this could reduce overconfidence in the initial assessment and motivate reconsideration of the validity of the assessment [12]. Furthermore, a heterogeneous set of experts, in combination with the Delphi process, has been found to reduce a possible optimism bias resulting from peoples' overconfidence [29,30]. In addition, various research results have underlined that Delphi's feedback and iterative process strongly improves forecast accuracy and reduces errors in predictions [11,15]. In general, research has shown that Delphi results improved from initial to final assessments [e.g. 31].

Although the Delphi method is suggested to be a powerful research tool in estimating the probability of future events and dealing with the limitations resulting from human probability judgments [e.g. 4], the impact of the desirability of an event on the estimated probability in Delphi studies remains unclear. This impact, commonly known as desirability bias, has been of recent interest in decision making and probability estimations [see 16 for a review, 32]. In probabilistic forecasting, various researchers have studied the relationship between desirability and probability assessments and identified positive correlations [e.g. 33,34]. With reference to Delphi, Rowe and Wright [15] used a Delphi-like research design and found that prediction accuracy of non-probabilistic forecasts decreases if participants' magnitude of desirability for the assessed short-term events increases. Rowe and Wright also identified that this effect decreases from the initial to the final assessment, depending on which kind of feedback